# The Significant Thorium Deposits of the United States

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Recently, thorium-based nuclear energy has experienced renewed attention as nations investigate new methods of meeting their growing energy supply requirements. Consideration of thorium as a potential energy source has reached the U.S. Congress, where in 2008 there are plans to introduce the Thorium Energy Independence and Security Act (Geotimes, v. 53, no. 6, p. 17). If India or another country proves successful in generating electricity safely and efficiently from a thorium-based nuclear power plant, then considerable interest and activity could focus on thorium exploration across the globe. Thus, it benefits the U.S. and other countries to identify and evaluate their indigenous thorium resources. Earlier studies of thorium districts conducted by the U.S. Geological Survey and the former U.S. Bureau of Mines left a considerable legacy of published information describing the geology and available resources in the primary thorium districts of the U.S.

All of the significant thorium resources in the U.S. appear to be genetically associated with alkalic magmatism. U.S. thorium deposits occur in epigenetic veins peripheral to alkaline intrusions; in alkalic igneous complexes or carbonatites; and in alluvial stream and beach deposits (placers) derived from the erosion of alkalic igneous terranes. Thorium's genetic association with alkaline igneous rocks also places thorium in close association with minerals that host other valuable elements, such as rare earth elements (REE), titanium and niobium.

Thorium vein districts are the largest high-grade (>0.1% $ThO_2$) thorium resources in the U.S. Two thorium vein districts in particular comprise the majority of the known high-grade thorium resources in the U.S.—the Lemhi Pass district along the border of southwestern Montana with Idaho, and the Wet Mountains area of south-central Colorado. Currently, claim staking, exploration, and reassessment of the thorite vein deposits in the Lemhi Pass district is being conducted by private interests.

Large, but low-grade, deposits of thorium (<0.1% $ThO_2$) occur in carbonatite stocks and some alkalic intrusions. U.S. examples include the Iron Hill carbonatite complex in southwestern Colorado and the Mountain Pass carbonatite in northeastern San Bernardino County, California. It seems unlikely that the thorium in most alkalic intrusions and carbonatites would be developed as the primary commodity; however, thorium could be exploited as a by-product along with the extraction of associated mineral resources (such as the large undeveloped titanium reserves at Iron Hill or renewed mining of the Mountain Pass REE deposits).

Thus far, the only thorium production in the U.S. came from alluvial deposits of monazite, which were mined by placer methods (sluicing, dredging) in intermontane stream deposits of Idaho (1909-1910, 1950s), stream and river deposits of the Piedmont region of North and South Carolina (1887-1917), and in beach deposits of northeastern Florida-southeastern Georgia (intermittent monazite recovery, 1916-1978). Mining of thorium from alluvial deposits has the advantages of relative ease of mining, rapid mineral separation, and the potential for co-product development. Co-products can include: REE obtained from monazite; titanium from ilmenite and rutile; iron from magnetite; zirconium and hafnium from zircon; and industrial-grade garnet, staurolite, tourmaline, kyanite, and sillimanite, which are used as abrasives and refractory minerals.